



## **Cultivating Equity in STEM through Inclusive Language**

**A Workshop on Emerging Research Themes  
April 8-10, 2022  
San Diego, California**

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**Suggested reference:** Herbers, J. M., Metcalf, H. E., and V. L. Rhodes. 2022. Problematic Jargon in STEM. ADVANCE Resource and Coordination Network, Washington, D.C.



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## Executive Summary

The ADVANCE Resource and Coordination (ARC) Network convened scholars from multiple disciplines for a 2-day workshop to prioritize under-studied research questions within the general theme of **Problematic Jargon in STEM**. The Research Advisory Board of the ARC Network, a National Science Foundation-funded initiative at the Women in Engineering Proactive Network (WEPAN), identified this theme as a primary area in need of further research exploration in academic science, technology, engineering, and mathematics (STEM) workplaces.

This theme was selected because language and terminology are integral parts of STEM culture and often reflect larger social structures and power dynamics. The language, rhetoric, metaphors, and key terminology within STEM fields shape accessibility and inclusion in those fields as well as research approaches and solutions.

Members of the workshop planning committee nominated scholars working in this area who represent a diverse array of disciplines, research specialties, institution types, career stages, and social demographic backgrounds. Twenty-six scholars convened in April 2022 and participated in a series of facilitator-led discussions designed to culminate in a research agenda of under-studied questions that will advance the understanding of language used by scientists, engineers, and practitioners that is non-inclusive.

By the end of our time together, the group prioritized these research and intervention topics:

- Understanding the social implications of language use on inclusion and marginalization in STEM
- Metahistorical compilation of previous name changes across disciplines
- Persuasion strategies for convincing scientists to change their usage
- Antiracism and anti-oppression curricular development
- Role of professional societies to effect culture change

These priority topics emerged from extensive discussion among workshop participants and are elaborated in the full report. In addition, other identified areas where research is needed include:

- How do we broaden the discussion to engage researchers and practitioners across disciplines?
- How can we move past language itself to study underlying cultural assumptions?

We encourage researchers to pursue these topics and explore the questions described within this report, which will be aided by collaboration across disciplines, including social sciences, humanities, and practitioners of STEM disciplines. We also invite researchers and practitioners to intervene in all problematic terminology, not just that discussed in this report. To that end, we are crowdsourcing a list of suggested inclusive terminology to replace problematic language. To contribute your suggestions, please visit: <https://bit.ly/inclusiveSTEM>



## Background

The ADVANCE Research Coordination (ARC) Network is funded by a cooperative agreement to the Women in Engineering ProActive Network from the National Science Foundation (HRD-1740860 and HRD-2121468). Its over-arching goal is to curate, disseminate, and support a community that shares research and promising practices for intersectional gender equity in higher education science, technology, engineering, and mathematics (STEM) departments. Through ARC’s Emerging Research Workshops, it also has a mission to identify emerging research themes related to intersectional gender equity in STEM and directions for new research in those areas.

The ARC Network is supported by several advisory committees, including the Research Advisory Board (RAB). As part of its work, the RAB is charged with identifying important topics emerging in the literature on intersectional gender equity in STEM. Subsequent goals include recruiting a diverse cohort of scholars who commit to participating in a 2-day workshop on that topic. The workshop itself is designed to identify important questions for which additional research is needed, using intersectionality as a framework. In the autumn of 2020, the RAB recommended that ARC host an Emerging Research Workshop on the general topic of Problematic Jargon in STEM.

This theme was selected because language and terminology are integral parts of STEM culture and often reflect larger social structures and power dynamics. The language, rhetoric, metaphors, and key terminology within STEM fields shape accessibility and inclusion in those fields as well research approaches and solutions. For example, in computing, engineering, and technology, the commonly used terminology of master/slave to refer to primary and secondary parts and male/female to refer to “mating” connectors reflect problematic metaphors steeped in white supremacy as well as sexism and heteronormativity (Eglash, 2007; Fiormonte, Chaudhuri, & Ricaurte, 2022; Miller et al., 2021).

The RAB recruited a Planning Committee (see page 2) to further define the theme, outline potential topics for discussion, identify scholars working in the area, and plan the workshop itself. The Committee started its work in spring 2021. Throughout its deliberations, the Planning Committee focused on recruiting scholars to participate in the workshop by considering a broad range of variables, including discipline, institution type, career stage, and the aspects of identity they study (gender, ethnicity, sexuality, citizenship, socio-economic status, disability, et al). The resulting group (see page 2) included scholars working in various STEM disciplines, including computer science, biology, sociology, gender studies, public policy, and economics; participants included faculty of all ranks, graduate students, postdocs, and representatives of professional societies. The identities of the scholars were diverse, as well, which brought added richness and deeper insights to the discussions.

In 2022, we developed a draft of this report and circulated it widely among the community of research and practice. Comments and suggestions received from that audience are included in the text below.



## Workshop Description

The Planning Committee designed the workshop to proceed from a general overview of language use towards prioritizing specific research questions and areas for intervention. We began the workshop by establishing group norms and shared understanding to create a space where authentic conversations could take place over the course of two days. See Appendix I for the full agenda.

### Day 1

The overall goal for the first day was **Developing a Shared Understanding for a Research Roadmap**. Participants engaged in conversations designed to elicit varying perspectives, come to consensus about workshop goals, and identify priority topics for further research.

#### Task 1

Our first task was to gain an appreciation for the expertise among participants, and to agree on vocabulary. To that end, participants were paired randomly. Within each pair, individuals were asked to learn about each other, and then to introduce their partner to the larger group.

Thereafter, small groups (5-7 individuals) were formed to expand the conversation around the following questions:

- 1) *What is the research/work you do and how does it apply to “problematic jargon in STEM”?*

Disciplines and areas of expertise of our participants included:

1. Communication studies
2. Rhetoric
3. Philosophy of science
4. Sociology
5. Medicine
6. Environmental science
7. Entomology
8. Botany
9. Engineering/ computer science
10. History of science
11. Women’s health
12. Racism in science

Some participants were actively questioning jargon in their own scientific fields while others studied STEM disciplines from social science/humanities perspectives.



2) *What is your understanding of “problematic jargon that reinforces social inequities”?*

Participants discussed not only jargon, but also the use of metaphor and naming conventions. Some metaphors are helpful, especially in aiding non-scientists in understanding a concept, such as those which invoke human agency (e.g., blueprint, recipe). However, participants raised three major ways in which the use of metaphor in STEM can be problematic:

1. **It can reinforce existing power structures** (e.g., by positioning maleness/whiteness/ heterosexuality/ ableism as the norm) and exacerbate marginalization for less powerful individuals. For example, the medical term for female genitalia *pudendum* derives from the Latin word for “shame” (Draper, 2020; Gross, 2021). In electronics, plug and socket morphology that uses the terms “male” and “female” overtly references anatomy, and normalizes heterosexuality as well (Fiormonte, Chaudhuri, & Ricaurte, 2022; Miller et al., 2021). Phrases such as “scientific frontier” and “invasive species” validate imperial/ colonial western thought, while “war on cancer” reinforces a militaristic mindset (Cardozo & Subramaniam, 2013; Rodgers, 2008; Shackleton et al., 2019).
2. **It can limit the way we study scientific phenomena.** By imposing a metaphor on a scientific process/ phenomenon, we tend to frame thinking within that metaphor and may be hindered from alternative constructs. For example, the use of male-power words like “harem” to describe mating systems of animals such as horses or elephant seals implies females exert no mate choice (Zuk, 1993).
3. **It can lead to direct human harm.** A stark example is how a binary mindset concerning human sex has led to irreversible surgeries on infants born intersex (with both male and female genitalia; Gross, 2022).

When discussing problematic naming conventions, participants shared that in STEM fields, many species are named for white men whose backgrounds are problematic (e.g., Audubon bought and sold slaves), geography is referenced in ways that can promote racism (e.g., Asian flu), or explicitly racist words are used (e.g., Gypsy Moth).

Participants indicated that these problematic terms are used in multiple domains and thus can have multiple effects. In addition to scholarly discourse, these terms are also used in the classroom, outreach to the public, doctor-patient communication, and more. These varied contexts can cause terms to be normalized in everyday use among non-scientists as well. For example, gender and sex are often conflated, and race for humans is a social construct not validated by science, despite the popular belief that race is biological. These examples illustrate how word choice can encourage us to discretize traits that are continuously variable.

- 3) *To what extent has your work/disciplines/field addressed the issue of non-inclusive language and human metaphors that perpetuate inequities? Offer what you know about specific examples from your work/field/discipline.*

During small group conversations, participants shared ways in which their fields have begun to address problematic language use in STEM and how those efforts have been received. A few examples that surfaced include:

1. Rhetoricians have been particularly active in this endeavor (e.g., the Association for the Rhetoric of Science, Technology, and Medicine).
2. Some scientific disciplines are beginning to question use of certain terms, but those who lead such challenges are often met with stiff resistance or apathy.
3. The STEM researchers and practitioners who use problematic terms rarely collaborate with the humanists and social scientists who study language and power, suggesting a strong need for coalitions across disciplines to effect change.

Thereafter, a whole group debrief explored various perspectives, generating lively discussion. Emerging themes from that conversation emphasized:

1. **Use of language/ metaphor is not merely convenience but conveys messages about power.** Binary thinking (either/or) rather than inclusive thinking (spectrum, diversity) can reinforce existing power structures, leading to marginalization of some individuals and/or groups.
2. **We should be concerned not just with jargon (metaphors used as technical terms) but also other conventions,** such as naming of species, anatomical structures, and other language use that can be problematic.
3. **We need much more empirical research on the impact of using problematic metaphors/ jargon/ naming in STEM.** While we can easily point to associations with power structures (e.g., use of military terms, male-dominated metaphors), we actually know far less about the effects on marginalized groups of using such terms. Likewise, the use of more equitable and inclusive language in STEM and its impacts would be an area ripe for research.
4. **A beginning framework for assessing metaphors was proposed with three criteria.** *Aptness* refers to whether the metaphor has convincing similarities to the scientific phenomenon it addresses; *heuristic value* describes the use of metaphor to make a complex scientific phenomenon understandable to a general audience; *equitability* rates the metaphor for its relationship to existing power structures and possible exclusionary effects. That framework had a





mixed reception from our participants, and we offer it as a possible starting point for other researchers. For example, the use of “slavery” to describe behavior of some ant species that raid nests of other species is problematic from several perspectives. First its *aptness* has been questioned because the behavior departs from the institution of human slavery in numerous ways (Herbers, 2007). Second, the *heuristic value* of this metaphor is limited because the behavior itself is self-explanatory. Third, the *equitability* of the term is low. Using a slavery metaphor reinforces harmful human behavior because it implies slavery is part of the natural order.

## Task 2

Our second task was to develop a shared understanding for a research and intervention roadmap, using a technique known as the World Café: for each conversation, participants engaged in discussion with a small group of colleagues. Within each small group, a host was charged with maintaining focus and ensuring that all voices were heard, and a scribe took notes of the discussion. Once the discussion had concluded, the facilitator asked each group to report out; in that way, everyone had a sense of communal responses. Thereafter, individuals moved to assort into new groups, which maximized opportunities for creative interaction.

Questions posed and summary responses were:

### Question 1: *What do we know about the effects of problematic jargon in STEM?*

- In health care, metaphors are essential to patient understanding, and words matter. For example, we know that patients who are told cancer is a challenge rather than an obstacle (or worse, punishment) have better outcomes (Degner et al., 2003). In other cases, the choice of words can discourage individuals from seeking treatment. For example, patients with sickle-cell anemia are called “sicklers” by physicians, who often treat them as difficult and ignorant about their own bodies (Glassberg et al., 2013).
- Usage of metaphor places restrictions on how researchers think about problems. For example, use of “invasive” species implies agency on the part of pests, although many such species simply occupy niches created by human disturbance (Cardozo & Subramaniam, 2013; Shackleton et al., 2019). They are not invaders, but rather opportunists. Furthermore, when a metaphor becomes entrenched it can reinforce societal paradigms, in this case of militarism and xenophobia.
- Use of language that evokes power (e.g., war, frontier, individualism) can discourage engagement by those who do not accept those structures of power. Students in particular may not be attracted to fields that use alienating metaphors (e.g., master and slave systems in engineering). Non-inclusive language limits who is attracted to the field, which further reinforces prevailing paradigms. The collaborative nature of science is best achieved when multiple perspectives are engaged, and thus use of non-inclusive language limits the community engaged in scientific discourse.



**Question 2:** *What might be done (taught, created, researchers, governed, etc.) and by whom, to eliminate the use of non-inclusive language and to intentionally use inclusive language in STEM? Consider professional societies, funding agencies, et al.*

- Educators, present and future, need critical training on the use of language and students should be encouraged to share their experiences. Embedding such training and listening into STEM curricula is necessary to avoid it being perceived as a nicety or political correctness.
- Educators also need a structure to support intentional changes in language. Educators often feel pressure to teach using problematic terminology so that their students are prepared for other courses where that terminology will be used and expected to be understood.
- The relative lack of social perspectives in STEM education reflects a prioritization of STEM content over understanding the social contexts in which STEM operates. Professional societies and accreditation bodies have key roles to play in encouraging the integration of humanistic/social science perspectives into STEM education.
- So much of what is taught reflects the way textbooks are organized and use language. We must engage with authors and publishers, and professional societies can develop standards for language use (e.g., American Chemical Society, 2022).
- Much more research on how language use affects a diversity of individuals is needed to convince those attached to problematic language to reconsider usage.
- We do not know how international scholars (for whom English is not the primary language) interpret and use metaphors that reflect western culture.
- Eliminating metaphors is not the goal: replacing problematic (exclusionary) language might be achieved via different language choices, some of which include metaphors.
- Funding agencies must be alerted to this problem, and they should include consideration of inclusive language in their criteria.
- Highlighting this issue within and across disciplines is important; while one discipline may use a problematic term, there are similarities across disciplines that can make the problem visible. For example, the master/slave metaphor is used in computer science, engineering, photography, and entomology. A coalition of professional societies, as well as journal editors and textbook publishers, can induce substantive change.
- STEM communication in public spaces has a role to play as well. Recent pieces in the media (e.g., use of pudendum, change to *Spongy Moth*) have cast a spotlight on the problem and generated conversation across disciplines.

**Question 3:** *What are the possibilities for interdisciplinary collaboration on the issue of problematic jargon in STEM?*

- Collaboration across disciplines is essential! Scientists and engineers generally are not trained to study language and power structures. Questioning and then eliminating problematic terms will require collaboration between the primary users of the language (e.g., some STEM fields) and those who study it (e.g., humanities scholars and social scientists).



- Funding agencies could highlight this issue and require multidisciplinary teams to tackle it. The NSF Broader Impacts language might include specific reference to non-inclusive language. Research Experiences for Undergraduates (REU) programs also might be a good place to start since they require ethics training.
- Compiling dictionaries of scientific metaphor and histories of jargon change (e.g., Mongoloid to Down syndrome; Rodriguez-Hernandez & Montoya, 2011) would be very helpful.
- The arts can certainly contribute to this conversation as well. For example, the field of graphic medicine uses comic book techniques to explore issues in health care (Graphic Medicine, 2022).

**Question 4:** *What are the points of resistance? What will be most impactful in persuading colleagues to eliminate the use of non-inclusive language and intentionally use inclusive language? Who are the appropriate people or organizations to engage in this effort?*

- Some will not need to be persuaded and others will be unpersuadable: focus on the middle ground. Even these individuals, though, will need to see data on the issue.
- Focus on their values; if inclusivity is a value, then language needs to be as much a part of the discussion as unconscious bias has become.
- Scientists pay close attention to action from professional societies, journals, and funding agencies. Educators tend to be more receptive to these messages about inclusion, so perhaps start with the education sections of societies and funders.
- Healthcare practitioners focus on outcomes, so tying language use to health outcomes is essential.
- In some cases, institutional review boards (IRBs) can play a role; because they include non-specialists and members of the public, problematic language may be flagged that otherwise is overlooked.
- Textbooks can alter pedagogy, especially when large prestigious institutions adopt them.
- Both top-down and bottom-up approaches are needed, with support given to those individuals advocating for change.
- Stories are always persuasive, so collecting stories about how language is perceived by others is important. Narrative research is needed on how scientists at all levels and across fields have encountered exclusive language and/or what they would suggest by way of change.



## Day 2

We reconvened to first recap the previous day's work and put it into the context of mapping out the most promising research agendas and areas for intervention. After discussion, the group identified seven themes for future research. A poll of participants showed intense interest in developing five of those themes further.

### **Five Priority Research Areas (unranked):**

- Understanding the social implications of language use on inclusion and marginalization in STEM
- Metahistorical compilation of previous name changes across disciplines
- Persuasion strategies for convincing colleagues to change their usage
- Antiracism and anti-oppression curricular development
- Role of professional societies to effect culture change

The participants then assembled into five groups (one per area) according to their personal affinity for focused discussions centered on the following questions, and results of those discussions are given below:

1. Given the research area/issue, what question or set of questions, if answered, will make the greatest contribution to equity in STEM?
2. Designing the intervention, including problem definition, purpose, stakeholder, audience content outline, distribution of intervention, impacts and so on.
3. What new collaborations might foster the greatest success for this type of intervention?

### **Major Research/Intervention Area 1:**

#### **Understanding the social implications of language use on inclusion and marginalization in STEM**

Given that ours was the first workshop on the topic of problematic terms, there is a need for foundational work:

- Who is being marginalized and how is our language contributing to it?
- How does STEM language reinforce marginalization?
- How variable are perceptions of these terms and their effects?
- What are the priorities for redressing potential harm from language use?
- What are the areas that have been changed successfully?
- What are the social constructs and social implications of word choice?
- What alternatives might promote inclusivity?
- What are the impacts of more equitable and inclusive language in STEM?

To develop such a foundation for future work, scholars can use a variety of methods such as focus group, surveys, text mining, a crowdsourced database (see Appendix II), discourse



analysis, and application of phylogenetic methods. They can also assort terms into categories such as:

- Metaphors (which can be further subdivided by context)
- Latin, technical names
- Common names
- Eponyms
- Parts of speech that connote power and privilege (verbs, adjectives)

Historical analysis can uncover context for a term’s introduction, and ascribe to it moral value, its role in reinforcing cultural norms, use of binary versus spectrum thinking, and implications for marginalizing some groups. Rhetorical analysis can assess a term for heuristic value, aptness/accuracy, and social implications (e.g., oppression of marginalized groups, reinforcement of power structures, binary thinking).

This foundational work will depend on contributions from numerous disciplines, including those in STEM who are concerned about language use, social anthropologists, digital humanities, language studies, and those who classify (taxonomists, librarians). Indeed, a multidisciplinary approach is essential to elicit nuance and identify the most important pathways for future research.

## **Major Research/Intervention Area 2: Metahistorical compilation and analysis of previous language changes across disciplines**

Important examples of scientists abandoning harmful metaphors exist (e.g., use of “rape” to describe forced copulations in animals; Zuk, 1993), and we now need to collect and analyze such examples (Appendix II). Historical analysis of landmark changes can identify the compelling arguments and factors/parties that affected change, as well as resistance to change, effects of the change, and timelines. Just as important, we must analyze those calls for shifts in terminology that were *not* broadly successful (Herbers, 2020).

Such analyses should include:

- 1) What are background social factors that create a sense of urgency? In recent years the #MeToo, LGBTQ+ rights, Black Lives Matter, and other social movements have sparked broad introspection into and discussion about how systems of power, privilege, and oppression are recreated every day, including in language. In what ways have those critical conversations influenced the examination of STEM discourse?
- 2) Where and how does terminology change actually occur? Is usage restricted to researchers, or does it permeate to educational and outreach missions as well? Do such changes transform the popular lexicon as well?



- 3) Within the academic sphere, is the change restricted to scientific description, or does it also affect journal policies, professional society infrastructure, calls by funding agencies, and other institutional structures?
- 4) What were the arguments for shifts and what were the major points of resistance? For proposed changes that failed, were the arguments ignored or rebutted? For those that provoked change, what was the timeline and how long did resistance remain among practitioners?

This research area also will require multiple perspectives to explore interconnectedness of colonialism, sexism, racism, xenophobia, homophobia, transphobia, etc. Suggested methodologies include:

- Discourse analysis
- Text mining
- Case studies
- Rhetorical history
- Interviews, focus groups and oral histories, both of those who experienced/led/were involved in successful change and those resistant to change
- Content analysis
- Archival research
- Organizational analysis

We strongly encourage new collaborations among those trained in social and language analysis (e.g., humanists/social scientists) and other STEM researchers, practitioners, and educators. Some scientific societies have engaged such partners to develop policies and procedures to advance diversity, equity, and inclusion; inclusion of scholars who study language use is a logical adjunct to those efforts. Other key partners include journal editors/editorial boards, institutional review boards, textbook publishers, funding agencies, museums, and libraries.

### **Major Research/Intervention Area 3:**

#### **Persuasion strategies for convincing colleagues to change their usage**

A substantial amount of literature describes how western scientists think and behave. Historians, philosophers, anthropologists, sociologists, and other specialties document how hypotheses are constructed and tested, how bodies of evidence are marshalled to create theories, and how prevailing paradigms are reinforced or challenged. Our focus on language choice and use of metaphor bridges these disciplines to ask, *what causes scientists to question and possibly change accepted usage?* What are the points of resistance to change and how can we counter them? In what ways do these connect to values held by scientists (about truth, enhancing learning, contributing to the profession, etc.)?

Tying use of problematic terms to actual harm is essential. In general, scientists care about the social impact of their work, and persuasion will require demonstration that use of such terms has negative effects. Finding persuasive arguments can be informed by analysis of successes and failures of similar proposed shifts in thinking. For example, broad acceptance of the concept of



cognitive biases, particularly unconscious or implicit bias, rests upon well-controlled studies that show differential effects that serve to marginalize some groups (e.g., Moss-Racusin et al., 2014). Belief in the harmful consequences of unconscious/implicit bias, in turn, is producing shifts in how institutions search for new faculty and evaluate teaching effectiveness. On the other hand, clear documentation that active learning techniques are beneficial has not led to widespread changes in the classroom (Supiano, 2022). If our goal to change language use is to be successful, we must understand how scientists think about social issues within their disciplines.

The concept of resistance has two sides. There are those who resist current usage (*agents of change*) and those who resist proposed change (*agents of the status quo*). We must understand both groups: what motivates those who propose change, and what arguments are most likely to persuade others that such change is needed? Further, we must develop strategies to support both. For agents of change, especially if they are members of marginalized groups, what strategies can amplify the message to reach those in power? What are likely to be objections raised to that message, and how can those objections be countered? For those resisting change, what leverage points might prove most persuasive?

Elevating language use to prominence (not just relegated to political correctness) will require additional strategies. Where can such issues be discussed, and how can we ensure the discussion involves a broad audience? Might language use be folded into the ethics education required by funders and accreditors?

Layered strategies are likely to be useful. For example, senior or more established scientists may not be receptive to calls for change to entrenched terminology, but their students may be. Those working in research-intensive institutions, who generate much of the literature that uses problematic jargon, are likely both to be early adopters of change as well as resisters. Those working in teaching-intensive institutions have less power to change accepted terminology across a discipline but may be instrumental in identifying and documenting harm done by such terms. Journal editors and professional societies can play major roles by developing policies for acceptable terminology (*leading indicators*), and usage can be tracked in textbooks (*lagging indicators*).

Pursuing these agendas will require collaborations between social scientists, humanists, and agents of change in the scientific discipline itself. It is likely that different branches of STEM will require different approaches as well. Mixed research methods can produce both numbers-rich results (persuasive to quantitative scientists) as well as narratives that demonstrate impact on individuals.

## **Major Research/Intervention Area 4:** **Antiracism and anti-oppression curricular development**

This topic acknowledges that non-inclusive language is not a stand-alone problem but is embedded in and reflects structural inequities including racism/sexism/ableism/historical gender



roles and the like. Thus, a holistic remedy must involve challenging those structural inequities by dissecting power structures, and associated allocation of privilege.

Anti-oppression movements must include students, educators, community members, and those in power. Numerous disciplines must weigh in, from arts and humanities through to medicine and engineering. Furthermore, acknowledgment and analysis of structural oppression must pervade every discipline in the classroom and workplace.

A focus on the classroom must involve teachers, students, families, school board members, and the broader community. Prevailing teacher attitudes towards inclusivity are not well understood, placing a premium on surveying/ interviewing educators to probe their understanding, apprehensions, and tools they find most useful. Only thereafter can we provide resources and design interventions for teachers that can disrupt language and other forms of systematic oppression. Teachers must be comfortable handling discomfort in the classroom and learn how to provide safe environments.

The issue of community respect for education (especially public education) is complex and retaining/ regaining public trust will require honest and persistent communication about educational ideals, historical patterns of oppression, and structural barriers to equity. Researchers can identify strategies for educators, administrators, and community leaders that have worked to broaden public engagement and that led to curricular inclusion.

## **Major Research/Intervention Area 5:** **Role of professional societies to achieve culture change**

Professional societies are gatekeepers of culture within their respective disciplines, and scientific/engineering societies in particular can influence thinking among their members concerning inclusive practices. Furthermore, the broad membership of societies (researchers, educators, policymakers, including those in academia, government, NGOs, and the private sector) gives them leverage for achieving structural change.

Professional society efforts that can be leveraged for inclusivity range from publication of journals, to providing grants, awards programs, and conferences (Dean & Koster, 2014; Lincoln et al., 2012; Metcalf, 2016; Metcalf, Russell, & Hill, 2018). Many of these societies have committees/ task forces focused on diversity, equity, and inclusion that can be leveraged as well (e.g., American Chemical Society, American Geophysical Union, Society for Neuroscience). Furthermore, specific programs such as the ACCESS+ program housed at the Women in Engineering ProActive Network (WEPAN) engages professional societies to assess their current state and plan for interventions to advance equity and inclusion. Weaving consideration of non-inclusive language into those efforts might have high impact.

Societies formed to promote diversity, equity, and inclusion have special roles to play. For example, the National Society of Black Engineers (NSBE), American Indian Science and Engineering Society (AISES), Society for the Advancement of Chicanos/Hispanics and Native





Americans in Science (SACNAS), and others that serve historically marginalized groups share the goal of inclusivity, and a coalition of these societies that focus on language use could be especially powerful. In particular, they can work with and highlight grass-roots efforts among their members to suggest language changes that promote inclusivity.

Research on successes and failures of professional societies to achieve long-lasting inclusivity can inform future efforts centered on language use. While we can point to exemplars of change, other efforts have not been successful; our understanding of cultural change within science and engineering societies is thin. Tackling the problem of non-inclusive language will require better understanding of how such organizations work and the barriers to cultural change.

Science and engineering societies committed to examining their use of language should consider actively enlisting the aid of humanists and social scientists. For example, a society might offer grant support to a sociologist, or appoint a historian in residence. They could ask a librarian to perform textual analysis of their journal holdings/society documents for inclusivity.

Several potential funding sources were identified to jump-start this work, including from the National Science Foundation (e.g., the ADVANCE and LEAPS programs), the Allied Media Conference, the American Library Association, and more. Several participants committed to pursuing such funding for their disciplines.

## **Additional Research and Intervention Areas**

While the questions below were not fully discussed, there was strong agreement that they require further research; we offer these additional questions to the community interested in promoting use of inclusive language in STEM.

1. How do we broaden the discussion to engage across disciplines?
2. How can we move past language to study cultural assumptions that the language implies?



## End of Workshop

### Evaluation by participants

We asked participants to assess the workshop via an instrument that probed their experiences. Overall, participants gave the effort high marks for posing important questions, stimulating discussion, highlighting inter-disciplinary approaches, and converging on the most important next steps for the research community.

### An important outcome that needs your help!

We wish to continue compiling a crowdsourced list of suggested inclusive terminology to replace problematic language. To contribute your suggestions, please visit:

<https://bit.ly/inclusiveSTEM>

### Conclusion:

Since this was the first-ever workshop focusing on the topic, our main goals were to set an agenda for researchers who study the use of words by scientists and engineers, and to identify best practices for persuading disciplines to question usage and implications of metaphors that reinforce social inequities. We hope the community engages with the topics we identified and additional research on those topics is pursued.



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## Appendix I. Agenda for the Workshop

### Emerging Research Workshop: Problematic STEM Jargon

April 8-10, 2022

Hilton San Diego Gaslamp Quarter, San Diego, CA

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#### PARTICIPANT AGENDA

##### WORKSHOP GOAL

To strengthen participants' understanding about the use and impact of non-inclusive STEM language.

To identify new/emerging research themes and interventions in the area of incorporating inclusive language in STEM.

##### FRIDAY, APRIL 8, 2022

5:30 PM PT **Participant arrival & registration (Starlight Terrace North)**

6:30 PM **Welcome Dinner (Catalina)**  
Introductions and review of planned agenda. Additional thoughts welcomed.

##### SATURDAY, APRIL 9, 2021

8:00 AM PT **Breakfast (Starlight Terrace North)**

9:00 **Workshop introduction (Santa Rosa)**

9:30 **Partner introductions**

10:00 **Small group discussion**

- What is the work that you do and how does it apply to “problematic jargon in STEM”?
- What is your understanding of “problematic jargon that reinforces societal inequities”?
- To what extent has your work/discipline/field addressed the issue of non-inclusive language and human metaphors that perpetuate inequities? Offer what you know about specific examples from your work/field/discipline.

10:45 **Break**

11:15 **Large group debrief**

12:00 PM **Lunch (Starlight Terrace North)**



- 1:00      **Developing shared understanding for a research & intervention roadmap (Santa Rosa)**  
Participants will engage in a series of conversations designed to elicit varying perspectives, develop shared understanding, and reach conclusions about emerging research areas and interventions to eliminate the use of non-inclusive language and to intentionally use inclusive language in STEM fields/disciplines.
- (1) What do we know about the effects of problematic jargon in STEM?
  - (2) What might be done (taught, created, researched, governed, etc.), and by whom, to eliminate the use of non-inclusive language and to intentionally use inclusive language in STEM? Consider professional societies, funding agencies, etc.
- 2:15      **Break**
- 2:45      **Continue building research and intervention roadmap**
- (3) What are the possibilities for interdisciplinary collaboration on the issue of problematic jargon in STEM?
  - (4) What do scientists find persuasive? What will be most impactful in persuading colleagues to eliminate the use of non-inclusive language and intentionally use inclusive language? Who are the appropriate people or organizations to engage in this effort?
- 4:00      **Summarize the day and introduce goal(s) of second day**
- 4:30      **Break for dinner**
- 6:00 PM    **Dinner (Catalina)**

**SUNDAY, APRIL 10, 2022**

- 8:00 AM PT    **Breakfast (Starlight Terrace North)**
- 9:00      **Review workshop outcomes from Saturday, introduce plan for the day (Santa Rosa)**
- 9:15      **Identify prioritized research areas and/or interventions and self-organize into groups to begin in-depth planning**  
For small groups with a research focus:
- (1) Given the research area/issue, what question or set of questions, if answered, will make the greatest contribution to equity in STEM?





- (2) What research methods are going to be most useful for answering these questions?
- (3) What new collaborations might foster research in this area?

For small groups with an intervention focus:

- (1) Begin designing the intervention, including problem definition, purpose, stakeholders, audience, content outline, distribution of intervention, impacts, etc.
- (2) What new collaborations might foster the greatest success for this type of intervention?

10:45	<b>Break</b>
11:15	<b>Resume priority area discussion</b>
12:00 PM	<b>Lunch (Starlight Terrace North)</b>
12:45	<b>Report-outs from groups to share about their ideas and planning (Santa Rosa)</b>
1:30	<b>Workshop review and next steps</b> Workshop evaluation survey
2:00	<b>Depart for Airport</b>



## Appendix II. Examples of shifts in language use in STEM/society

- Junk DNA to noncoding DNA
- Gypsy Moth to Spongy Moth
- Pudenda to vulva
- Mongolism to Down's syndrome
- quantum primacy as a replacement for quantum supremacy
- Shifts away from Caucasian
- Gene nomenclature changes (e.g., “dunce” gene in fruit flies; Christmann, 2014)
- Master/slave in electronics
- Change from negro to Black
- Creation of Ms.
- *Journal of Negro History* changing to *Journal of African American History*
- Slaves to enslaved people
- Women's studies to Gender studies, Women's and Gender Studies, or Women, Gender, and Sexuality Studies
- Shifts in language to describe gender and behavior along a spectrum as opposed to binary
- DSM changes to stop pathologizing queerness and gender identity
- Changes in pronouns (and use of they as a singular pronoun in publication guidelines)
- Regression in statistics (not yet successful)
- “invasive” species (not yet successful)
- Genetic population instead of race (not fully successful)
- Ethnic group instead of race (not fully successful)
- Male/Female to plug/socket in electronics (not fully successful)

